

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 2 of 15

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

Claims 1-21 (canceled).

Claim 22 (currently amended): A method for manufacturing a semiconductor device, comprising the steps of:

providing an amorphous semiconductor film including a catalyst element in at least a portion thereof, the catalyst element being capable of promoting crystallization of the amorphous semiconductor film;

performing a first heat treatment on the amorphous semiconductor film so as to crystallize at least a portion of the amorphous semiconductor film, thereby obtaining a semiconductor film including a crystalline region;

patterning the semiconductor film to form an island-shaped semiconductor layer including the crystalline region;

forming a gate insulating film on the island-shaped semiconductor layer;

selectively thinning or selectively removing a portion of the gate insulating film that is located outside a region of the island-shaped semiconductor layer where a channel region, a source region and a drain region are formed;

forming a gettering region capable of attracting the catalyst element in a region outside the region of the island-shaped semiconductor layer where the channel region, the source region, and the drain region are formed ~~where the gate insulating film on the island-shaped semiconductor layer has been thinned or removed;~~

doping the crystalline region of the island-shaped semiconductor layer with an impurity for forming the source region and the drain region; and

performing a second heat treatment so as to move at least a portion of the

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 3 of 15

catalyst element in the island-shaped semiconductor layer to the gettering region.

Claim 23 (original): The method for manufacturing a semiconductor device according to claim 22, wherein the island-shaped semiconductor layer further includes an amorphous region, and at least a portion of the gettering region is formed in the amorphous region.

Claim 24 (original): The method for manufacturing a semiconductor device according to claim 22, wherein at least a portion of the gettering region is formed in the crystalline region.

Claim 25 (original): The method for manufacturing a semiconductor device according to claim 22, wherein the impurity doping step includes a step of doping at least one of an n-type impurity and a p-type impurity before performing the second heat treatment.

Claim 26 (original): The method for manufacturing a semiconductor device according to 22, wherein the step of forming the gettering region includes a step of doping the island-shaped semiconductor layer with a gettering element capable of attracting the catalyst element.

Claim 27 (withdrawn): The method for manufacturing a semiconductor device according to claim 26, wherein at least a portion of the impurity doping step is performed before the gettering element doping step.

Claim 28 (withdrawn): The method for manufacturing a semiconductor device according to claim 26, wherein at least a portion of the impurity doping step is performed after the gettering element doping step.

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 4 of 15

Claim 29 (original): The method for manufacturing a semiconductor device according to claim 26, wherein at least a portion of the impurity doping step is performed simultaneously with the gettering element doping step.

Claim 30 (original): The method for manufacturing a semiconductor device according to claim 26, wherein the gettering element doping step is performed by selectively doping a region of the island-shaped semiconductor layer where the gate insulating film has been thinned or removed, with a gettering element.

Claim 31 (original): The method for manufacturing a semiconductor device according to claim 25, wherein the gettering element doping step includes a step of doping a region of the island-shaped semiconductor layer where the gate insulating film has been thinned or removed, with a gettering element at a higher concentration than that in the source region and the drain region.

Claim 32 (original): The method for manufacturing a semiconductor device according to claim 26, wherein the gettering element includes a group VB impurity element providing n-type conductivity.

Claim 33 (original): The method for manufacturing a semiconductor device according to claim 26, wherein the gettering element includes a group VB impurity element providing n-type conductivity and a group IIIB impurity element providing p-type conductivity.

Claim 34 (withdrawn): The method for manufacturing a semiconductor device according to claim 26, wherein the gettering element includes at least one element selected from the group consisting of Ar, Kr and Xe.

Claim 35 (original): The method for manufacturing a semiconductor device

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 5 of 15

according to claim 26, wherein a concentration of the gettering element in the gettering region is about 1×10^{19} atoms/cm³ to about 3×10^{21} atoms/cm³.

Claim 36 (original): The method for manufacturing a semiconductor device according to claim 22, wherein the gettering region formation step includes a step of amorphizing a region of the island-shaped semiconductor layer where the gate insulating film has been thinned or removed to a higher degree than the source region and the drain region.

Claim 37 (original): The method for manufacturing a semiconductor device according to claim 22, wherein the gettering region is formed in the island-shaped semiconductor layer outside a region thereof through which electrons or holes move.

Claim 38 (currently amended): The method for manufacturing a semiconductor device according to claim 22 24, wherein the gettering region is formed so as to be adjacent to at least one of the source region and the drain region and so as not to be adjacent to the channel region.

Claim 39 (currently amended): The method for manufacturing a semiconductor device according to claim 22 24, further comprising, after the second heat treatment step, a step of forming a line that is in contact with a region including at least a portion of the source region or the drain region.

Claim 40 (currently amended): A method for manufacturing a semiconductor device, comprising the steps of:

providing an amorphous semiconductor film including a catalyst element in at least a portion thereof, the catalyst element being capable of promoting crystallization of the amorphous semiconductor film;

performing a first heat treatment on the amorphous semiconductor film so as to

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 6 of 15

crystallize at least a portion of the amorphous semiconductor film, thereby obtaining a semiconductor film including a crystalline region;

patterning the semiconductor film to form a plurality of island-shaped semiconductor layers each including the crystalline region;

forming a gate insulating film on each of the plurality of island-shaped semiconductor layers;

forming a gate electrode on the gate insulating film on each of the plurality of island-shaped semiconductor layers;

selectively thinning or selectively removing a portion of the gate insulating film that is located outside a region of at least one of the plurality of island-shaped semiconductor layers where a source region and a drain region are formed and that is located in a region where the gate electrode is not formed;

performing a doping process for forming the source region and the drain region in each of the plurality of island-shaped semiconductor layers and for forming a gettering region capable of attracting the catalyst element in a region outside the region of the at least one of the plurality of island-shaped semiconductor layers where the source region and the drain region are formed ~~of the at least one island-shaped semiconductor layer where the gate insulating film has been thinned or removed~~; and

performing a second heat treatment so as to move at least a portion of the catalyst element in the at least one island-shaped semiconductor layer to the gettering region.

Claim 41 (original): The method for manufacturing a semiconductor device according to claim 40, wherein the island-shaped semiconductor layer further includes an amorphous region, and at least a portion of the gettering region is formed in the amorphous region.

Claim 42 (original): The method for manufacturing a semiconductor device according to claim 40, wherein at least a portion of the gettering region is formed in the

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 7 of 15

crystalline region.

Claim 43 (withdrawn): The method for manufacturing a semiconductor device according to claim 40, wherein the at least one island-shaped semiconductor layer includes an island-shaped semiconductor layer of an n-channel thin film transistor and an island-shaped semiconductor layer of a p-channel thin film transistor, the doping step including:

an n-type doping step of doping a region of the island-shaped semiconductor layer of the n-channel thin film transistor where the source region and the drain region are formed and a region of the island-shaped semiconductor layer of the p-channel thin film transistor where the gettering region is formed, with an impurity element providing n-type conductivity; and

a p-type doping step of, after the n-type doping step, doping a region of the island-shaped semiconductor layer of the p-channel thin film transistor where the source region, the drain region and the gettering region are formed, with an impurity element providing p-type conductivity.

Claim 44 (original): The method for manufacturing a semiconductor device according to claim 40, wherein the at least one island-shaped semiconductor layer includes an island-shaped semiconductor layer of a p-channel thin film transistor, and the plurality of island-shaped semiconductor layers further include an island-shaped semiconductor layer of an n-channel thin film transistor, the doping step including:

a p-type doping step of doping a region of the island-shaped semiconductor layer of the p-channel thin film transistor where the source region, the drain region and the gettering region are formed, with an impurity element providing p-type conductivity; and

an n-type doping step of, after the p-type doping step, doping a region of the n-channel thin film transistor where the source region and the drain region are formed and a region of the island-shaped semiconductor layer of the p-channel thin film transistor where the gettering region is formed, with an impurity element providing n-type

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 8 of 15

conductivity.

Claim 45 (withdrawn): The method for manufacturing a semiconductor device according to claim 40, wherein the at least one island-shaped semiconductor layer includes an island-shaped semiconductor layer of an n-channel thin film transistor and an island-shaped semiconductor layer of a p-channel thin film transistor, the doping step including:

an n-type doping step of doping a region of the island-shaped semiconductor layer of the n-channel thin film transistor where the source region, the drain region and the gettering region are formed and a region of the island-shaped semiconductor layer of the p-channel thin film transistor where the gettering region is formed, with an impurity element providing n-type conductivity; and

a p-type doping step of, after the n-type doping step, doping a region of the island-shaped semiconductor layer of the p-channel thin film transistor where the source region, the drain region and the gettering region are formed and a region of the island-shaped semiconductor layer of the n-channel thin film transistor where the gettering region is formed, with an impurity element providing p-type conductivity.

Claim 46 (original): The method for manufacturing a semiconductor device according to claim 40, wherein the at least one island-shaped semiconductor layer includes an island-shaped semiconductor layer of an n-channel thin film transistor and an island-shaped semiconductor layer of a p-channel thin film transistor, the doping step including:

a p-type doping step of doping a region of the island-shaped semiconductor layer of the p-channel thin film transistor where the source region, the drain region and the gettering region are formed and a region of the island-shaped semiconductor layer of the n-channel thin film transistor where the gettering region is formed, with an impurity element providing p-type conductivity; and

an n-type doping step of, after the p-type doping step, doping a region of the

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 9 of 15

island-shaped semiconductor layer of the n-channel thin film transistor where the source region, the drain region and the gettering region are formed and a region of the island-shaped semiconductor layer of the p-channel thin film transistor where the gettering region is formed, with an impurity element providing n-type conductivity.

Claim 47 (original): The method for manufacturing a semiconductor device according to claim 40, wherein:

the step of selectively thinning or selectively removing a portion of the gate insulating film of the at least one island-shaped semiconductor layer includes a step of forming a mask on the source region and the drain region of the at least one island-shaped semiconductor layer, and a step of etching the gate insulating film using the mask; and

the mask is used in the doping step.

Claim 48 (withdrawn): The method for manufacturing a semiconductor device according to claim 43, wherein the step of selectively thinning or selectively removing a portion of the gate insulating film of the at least one island-shaped semiconductor layer is performed between the n-type doping step and the p-type doping step.

Claim 49 (original): The method for manufacturing a semiconductor device according to claim 44, wherein the step of selectively thinning or selectively removing a portion of the gate insulating film of the at least one island-shaped semiconductor layer is performed between the n-type doping step and the p-type doping step.

Claim 50 (withdrawn): The method for manufacturing a semiconductor device according to claim 48, wherein:

the p-type doping step includes a step of forming a mask covering a region of each of the plurality of island-shaped semiconductor layers that does not need to be doped with an impurity element providing p-type conductivity; and

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 10 of 15

the mask is used in the step of selectively thinning or selectively removing a portion of the gate insulating film of the at least one island-shaped semiconductor layer.

Claim 51 (withdrawn): The method for manufacturing a semiconductor device according to claim 49, wherein:

the n-type doping step includes a step of forming a mask covering a region of each of the plurality of island-shaped semiconductor layers that does not need to be doped with an impurity element providing n-type conductivity; and

the mask is used in the step of selectively thinning or selectively removing a portion of the gate insulating film of the at least one island-shaped semiconductor layer.

Claim 52 (withdrawn): The method for manufacturing a semiconductor device according to claim 50, wherein the step of selectively thinning or selectively removing a portion of the gate insulating film of the at least one island-shaped semiconductor layer includes a step of removing the mask.

Claims 53-61 (canceled).

Claim 62 (original): The method for manufacturing a semiconductor device according to claim 40, wherein a concentration of the impurity element providing n-type conductivity for doping the gettering region is about 1×10^{19} atoms/cm³ to about 1×10^{21} atoms/cm³, and a concentration of the impurity element providing p-type conductivity for doping the gettering region is about 1.5×10^{19} atoms/cm³ to about 3×10^{21} atoms/cm³.

Claim 63 (original): The method for manufacturing a semiconductor device according to claim 22, wherein the second heat treatment is performed so as to activate at least one of an impurity providing n-type conductivity and an impurity providing p-type conductivity that are implanted into the source region and the drain region of the plurality of island-shaped semiconductor layers.

Serial No.: 10/743,151
Reply to the Office Action dated November 3, 2005
February 2, 2006
Page 11 of 15

Claim 64 (original): The method for manufacturing a semiconductor device according to claim 22, wherein the step of providing an amorphous semiconductor film includes the steps of:

forming a mask having an opening therein on the amorphous semiconductor film;
and

doping a selected region of the amorphous semiconductor film with the catalyst element through the opening.

Claim 65 (original): The method for manufacturing a semiconductor device according to claim 22, wherein the catalyst element is at least one element selected from the group consisting of Ni, Co, Sn, Pb, Pd, Fe and Cu.

Claim 66 (original): The method for manufacturing a semiconductor device according to claim 22, further comprising, after the first heat treatment, a step of irradiating the semiconductor film with laser light.

Claim 67 (withdrawn): A semiconductor device manufactured by the manufacturing method according to claim 22.

Claims 68 and 69 (canceled).